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To fax number 0031 70 340 3980 for the attention of Ms I Viegas da Cruz

Dear Sirs,

PCT Patent Application No. PCT/GB2003/003258
Based on United Kingdom Patent Application No. 0216982.9
Applicant: Aberdeen University
Short title: Exercise Apparatus

We write in response to the Written Opinion dated 19 August 2004 issued in respect of the above PCT application, and the PCT/IPEA/427 dated 14 October 2004. In this regard, we are appreciative of the extension of time that was allowed on this case.

We attach amended pages 2 and 5 to 14 to replace pages 2 and 5 to 14 presently on file.

Claim 1 has been amended to include the feature of previous claim 19.

New dependent claim 23 has been added, the basis for which can be found at page 5 lines 14-16.

Claim 24, previously an independent method claim, now contains a reference to the preceding apparatus claims, and previous dependent method claim 25 has been deleted.

The remaining claims and their dependencies have been renumbered for consistency.

Claims 25 and 26 have been retained since claims of this type are allowable in

certain territories.

Finally, appropriate amendments have been made to pages 2 and 5 to 10 in order to bring the description into line with the amended claims.

It is noted that the Examiner considers previous claim 19 (the features of which are now included in amended claim 1) to be novel but to lack an inventive step over D1 to D6. In the absence of any indication of the particular document(s) over which previous claim 19 is alleged to lack an inventive step, we provide the following general comments on the prior art and how the present invention differs therefrom:

The present invention, as defined in amended claim 1, now relates to:

Apparatus for muscular stimulation of a user, which apparatus comprises a pressure sensor, a control unit to which pressure values sensed by the pressure sensor are fed, and a vibrational stimulator for applying vibrational stimulation to a user, wherein the vibrational stimulator is activated by the control unit in response to the pressure sensor sensing an applied pressure which exceeds a threshold pressure value and wherein the vibrational stimulator can apply vibrational stimulation to a user via a unit which can reciprocally move relative to a user in response to the pressure sensor sensing an applied pressure which exceeds the threshold pressure.

Thus, in use, a user initially applies pressure to the unit to his/her maximum ability. This sets the initial pressure value. The user then sets the threshold pressure value, which is a percentage of the initial pressure value, for example 70%. The user can also set the required movement of the unit, including the direction, speed and magnitude of the movement. The user then applies pressure to the unit, and whenever the applied pressure exceeds the threshold value, the control unit activates the vibrational stimulator to apply vibrational stimulation to the user's muscles. If movement has been pre-set, then the part of the unit to which the pressure is being applied (i.e. the bar or plate, in preferred embodiments) moves according to the pre-set parameters. For example, when the hand bar is moving away from the user, the user must press harder to maintain vibration, and when the unit is moving towards the user, the user's force demands decrease. This feature lends variety to the device of the present invention, and presents an additional challenge to the user, thereby helping to combat the boredom often experienced with known exercise devices.

By contrast, D1 (WO 02/053084) discloses a apparatus suitable for vibratory stimulation of a user, which apparatus comprises a force sensor (15), a control unit (22) to which signals representing the force sensed by the sensor are fed, and a vibrator (16) for applying vibratory stimulation to a user, wherein the vibrator is activated by the control unit in response to the force sensor sensing a weight which is higher than the user's body weight.

The present invention therefore differs from that disclosed in D1 by the feature

that the vibrational stimulator can apply vibrational stimulation to a user via a unit which can reciprocally move relative to a user in response to the pressure sensor sensing an applied pressure which exceeds the threshold pressure, and is therefore novel over the disclosure of D1.

Furthermore, there is nothing in D1 which discloses or suggests such a feature. Rather, D1 is concerned purely with providing a device having a support platform on which a person stands and vertical standards on which the person pulls and pushes, to activate the vibrator. It is noted that there is little incentive for the user to work the device of D1 beyond the threshold value, as the vibration is activated when the threshold value is reached: the device of D1 does not have the additional dimension of movement, unlike the present invention.

It is also noted that the device of D1 directs the vibration almost wholly through the feet of the user, rather than the arm muscles. It is stated on page 4 line 32- page 5 line 2 that "At the top each standard is provided with a handle 21 which can be connected to the standard via flexible vibration damping connections, e.g. of rubber, so that vibrations travelling from body to platform, and vice versa, via the arms of the user are minimised." This is in complete contrast to the preferred embodiments of the present invention (see, for example, Figure 1 in which numerals 8 and 10 refer to first and second vibrational stimulators) in which vibrational stimulation is delivered directly to the working muscles.

It is therefore considered that the invention as claimed in the amended claims is novel and involves an inventive step over the disclosure of D1.

D2 (US 6 039 679) discloses apparatus for muscular stimulation of a user, which apparatus comprises pressure sensitive switches (28), control means (60,62,64,66,68) to which pressure values sensed by the pressure sensitive switches are fed, and a motor (30) for applying vibrational stimulation to a user, wherein the motor is activated by the control means in response to the pressure sensitive switches sensing an applied pressure which exceeds a threshold pressure value.

The present invention therefore differs from that disclosed in D2 by the feature that the vibrational stimulator can apply vibrational stimulation to a user via a unit which can reciprocally move relative to a user in response to the pressure sensor sensing an applied pressure which exceeds the threshold pressure, and is therefore novel thereover. Furthermore, there is nothing in D2 to motivate the skilled person to arrive at the present invention, either on its own or in combination with any other cited document. It is therefore considered that the invention as claimed in the amended claims also involves an inventive step over the disclosure of D2.

D3 (EP 1 121 956) discloses an automatic device for improved muscular stimulation of a passive user by optimising the contraction frequency according to particular muscle types. No exercise is involved. This document was included in the International Search Report as a document defining the general state of the art which is not considered to be of particular relevance.

D4 (EP 0 335 616) discloses an exercise device comprising a user-operated air pump. This document was included in the International Search Report as a document defining the general state of the art which is not considered to be of particular relevance.

D5 (US 4 705 271) discloses an exercise device comprising a bench having a bar pivotally mounted thereon. The bar has connected thereto a hydraulic actuator for developing a resistive force against the movement of the bar. This document was included in the International Search Report as a document defining the general state of the art which is not considered to be of particular relevance.

D6 (SU 1 447 385) appears to disclose an alternative exercise apparatus. This document was included in the International Search Report as a document defining the general state of the art. It was not considered to be of relevance to any of the claims.

It is clear that the amended claims are novel over the cited prior art. It is also clear from the foregoing that none of the cited prior art documents could possibly be considered, either on its own or in combination with any of the other cited documents, to be relevant to the inventive step of the amended claims.

In light of the foregoing, we believe that the claims are patentable, and look forward to receiving a favourable International Preliminary Examination Report in due course.

Yours faithfully,

WILLIAMS; Paul Edwin
Authorized Representative

Enc. Amended pages

which exceeds a threshold pressure value, and wherein the vibrational stimulator can apply vibrational stimulation to a user via a unit which can reciprocally move relative to a user in response to the pressure sensor sensing an applied pressure which
5 exceeds the threshold pressure.

The apparatus according to the present invention thus provides vibrational stimulation to a user in response to the pressure sensor sensing an applied pressure by the user above a threshold
10 value. Thus, the user must expend a certain amount of physical effort in order to activate the vibrational stimulator, the amount of physical effort required being determined by the level at which the threshold pressure value is set.

15 Preferably, the vibrational stimulator is deactivated when the pressure sensor ceases to sense an applied pressure which exceeds the threshold pressure value. In this way, the user must continue to apply a pressure above the threshold value in order for the vibrational stimulator to remain activated, and thereby provide
20 vibrational stimulation to the muscles of the user.

The apparatus according to the present invention may conveniently take the form of exercise apparatus, for example of the type found in a gym.

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The apparatus may comprise one or more pressure sensors, and preferably comprises a first set of pressure sensors for detecting pressure applied through the hands of a user, and/or a second set of pressure sensors for detecting pressure applied through the feet
30 of a user. The first and second sets of pressure sensors may each respectively comprise one or more individual pressure sensors. More preferably, the apparatus comprises both said first and second sets of pressure sensors.

35 For example, the first set of pressure sensors may detect

respectively.

The vibrational stimulator(s) can preferably deliver vibrational stimulation to a user in a plurality of
5 amplitudes, frequencies and directions. More preferably, the amplitude, frequency and direction of vibration may be tailored by a user via the control unit. Each vibrational stimulator may comprise one or more individual vibration
10 engines, which may be controlled electronically according to parameters stored by the control unit. The vibrational parameters may be manually set by a user prior to use of the apparatus.

The vibrational stimulator(s) can provide vibrational
15 stimulation to a user via a unit which can either reciprocally move relative to a user in response to the pressure sensor sensing an applied pressure which exceeds the threshold pressure or which can remain substantially stationary relative to a user. For example, in the preferred embodiment referred
20 to above, the bar to which a user can apply pressure through their hands can be reciprocally moveable relative to the user, reciprocal movement of the bar being activated in response to the pressure sensor sensing an applied pressure which exceeds the threshold pressure, as for activation of the vibrational
25 stimulator. Alternatively, the bar can remain substantially stationary relative to a user. Similarly, in the aforementioned preferred embodiment, the plate to which a user can apply pressure through their feet can be reciprocally moveable, activated in the same way as the bar.
30 Alternatively, the plate can remain substantially stationary relative to a user.

The reciprocal movement may be, for example, substantially

towards and away from the user in the plane of symmetry of the user, laterally in a plane substantially orthogonal to the plane of symmetry of the user, a combination of movements in both of said planes, circular movement in one or both of said
5 planes, or a combination of any of such movements. Preferably, the direction(s) of the movement may be predetermined by the user, for example by pre-programming the control unit (e.g. via a touch screen display), as preferably may also the speed and magnitude of the reciprocal movement.
10

Thus, in use, a user of the apparatus according to the present invention applies an initial pressure to be sensed by the pressure sensor. The initial pressure is preferably the
15 maximum pressure which the user can apply at that instant. The pressure sensor senses the initial pressure value, which is stored by the control unit. A threshold pressure value is then determined based upon the initial pressure value. The threshold pressure value may be any value from 0% (i.e. no
20 pressure is required by a user to activate vibrational stimulation) to 100% (i.e. vibrational stimulation is only activated when a pressure equal to or exceeding the initial pressure value is sensed) of the initial pressure value, for example from 50 to 90% of the initial pressure value, or a
25 narrower range of for example 70 to 80%. The threshold pressure value may be automatically set by the control unit, or may be manually set by the user.

Subsequently, each time the pressure sensor senses a pressure
30 applied by the user which exceeds the threshold pressure value, the control unit activates the vibrational stimulator. Preferably, as referred to above, when the pressure sensor senses that the pressure applied by the user has dropped below

the threshold value, the control unit deactivates the vibrational stimulator. Thus, the user will only receive vibrational stimulation when sufficient pressure is applied to activate the vibrational stimulator, according to the
5 threshold pressure value stored by the control unit, for example as previously manually set by the user.

According to the present invention there is thus also provided a method for operating the above-described apparatus, which
10 method comprises the user applying an initial pressure which is sensed by a pressure sensor, recording the initial pressure value sensed by the pressure sensor, and applying vibrational stimulation to the user by a vibrational stimulator in response to the user applying pressure to the pressure sensor
15 which exceeds a threshold pressure value determined by the initial pressure value.

The apparatus and method according to the present invention thus have utility for exercising muscles, either as part of
20 a fitness regime, or a recovery program of a user from surgery or illness. The apparatus and method according to the present invention have the particular advantage over prior apparatus and methods in that they may be specifically tailored by the user to individual requirements. The apparatus and method
25 according to the present invention may be used as an evaluation tool for neuromuscular performance, to stimulate different muscles and joints in a user, and allows exercise or treatment at different levels of force applied by a user. However, the apparatus and method according to the present
30 invention is also suited for use in microgravity environments, for example beyond the earth's atmosphere, where exercising with weights, for example barbells, is ineffective.

An embodiment of the present invention will now be described in detail by way of example, with reference to the accompanying drawings, in which:

- 5 Figure 1 is a side view of a preferred embodiment of the apparatus according to the present invention; and
Figure 2 is a top view of the embodiment shown in Figure 1.

Referring to Figures 1 and 2, a preferred embodiment of the
10 apparatus of the present invention comprises first and second pressure sensors 2 and 4 respectively, in the form of first and second strain gauges, a control unit 6 to which pressure values sensed by the pressure sensors 2 and 4 are fed, and first and second vibrational stimulators 8 and 10 respectively
15 for applying vibrational stimulation to the user. The pressure values detected by the first and second pressure sensors 2 and 4 are fed to the control unit 6 via connections 12. The apparatus further comprises a touch screen display 14 by which the user may view in real time their performance on the
20 apparatus, and may input or change apparatus parameters, for example the threshold pressure value, or parameters of the vibrational stimulators 8 and 10.

As shown in Figures 1 and 2, the preferred embodiment of the
25 apparatus according to the present invention is designed for use by a supine user. The first pressure sensor 2 and first vibrational stimulator 8 form part of a unit which comprises a bar 16 against which the user pushes through their hands to apply pressure thereto. The second pressure sensor 4 and
30 second vibrational stimulator 10 form part of a unit which comprises a plate 18 against which the user pushes through their feet to apply pressure thereto.

The bar 16 and/or plate 18 are reciprocally moveable relative to a user in response to the first and/or second pressure sensors 2 and/or 4 respectively sensing an applied pressure which exceeds the threshold pressure. Thus, in the embodiment 5 shown in Figures 1 and 2, the bar 16 is reciprocally moveable towards and away from the direction of applied pressure through the arms of the user (i.e. upwards and downwards in the view shown in Figure 1) and/or the plate 18 is reciprocally moveable towards and away from the direction of 10 applied pressure through the feet of the user (i.e. left and right in the view shown in Figure 1). The direction, speed and magnitude of reciprocal movement of the bar 16 and plate 18 may be pre-determined by the user via the touch screen display 14. Thus, the user can choose to have the bar and/or 15 plate remain substantially stationary relative to the user.

Thus, in use, in the supine position the user initially applies pressure to the bar 16 and plate 18 to their maximum ability. These initial pressure values are sensed by the 20 first and second pressure sensors 2 and 4, and are stored in the control unit 6. The user then sets the threshold pressure value, for example 70% of the initial pressure value, using the touchscreen 14. The user then applies pressure to the bar 16 and plate 18, and whenever the first and second pressure 25 sensors 2 and 4 sense pressure values greater than the threshold value, the control unit 6 activates the first and second vibrational stimulators 8 and 10, to thereby stimulate the arm and leg muscles respectively of the user. When the pressure value sensed by the first and/or second pressure 30 sensors 2 and 4 drops below the threshold pressure value, then the control unit 6 deactivates the first and/or second vibrational stimulators 8 and 10 accordingly. As referred to hereinabove, the bar 16 and/or plate 18 are reciprocally

moveable relative to the user in response to the first and/or second pressure sensors 2 and/or 4 respectively sensing an applied pressure which exceeds the threshold pressure.

- 5 It will be understood that the embodiment illustrated describes the invention in one form only for the purposes of illustration. In practice, the invention may be applied to many different configurations, the detailed embodiments being straightforward for those skilled in the art to implement.

CLAIMS

1. Apparatus for muscular stimulation of a user, which apparatus comprises a pressure sensor, a control unit to which
5 pressure values sensed by the pressure sensor are fed, and a vibrational stimulator for applying vibrational stimulation to a user, wherein the vibrational stimulator is activated by the control unit in response to the pressure sensor sensing an applied pressure which exceeds a threshold pressure value
10 and wherein the vibrational stimulator can apply vibrational stimulation to a user via a unit which can reciprocally move relative to a user in response to the pressure sensor sensing an applied pressure which exceeds the threshold pressure.
- 15 2. Apparatus according to claim 1 wherein the vibrational stimulator is deactivated when the pressure sensor ceases to sense an applied pressure which exceeds the threshold pressure value.
- 20 3. Apparatus according to claim 1 or 2 which comprises a first set of pressure sensors for detecting pressure applied through the hands of a user, and/or a second set of pressure sensors for detection of pressure applied through the feet of a user.
- 25 4. Apparatus according to claim 3 which comprises both said first and second sets of pressure sensors.
5. Apparatus according to claim 3 or 4 wherein the first set
30 of pressure sensors detects pressure applied to a bar against which a user can push or pull with their hands.
6. Apparatus according to any one of claims 3, 4 or 5

wherein the second set of pressure sensors detects pressure applied to a plate against which a user can push with their feet.

5 7. Apparatus according to any preceding claim wherein the pressure sensor comprises a strain gauge.

8. Apparatus according to any preceding claim for use by a supine user.

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9. Apparatus according to any preceding claim wherein the control unit comprises a central processing unit.

10. Apparatus according to any preceding claim wherein the
15 control unit allows a user to set the frequency, amplitude and/or direction of vibrations generated by the vibrational stimulator, and/or stores information concerning use of the apparatus by a user.

20 11. Apparatus according to any preceding claim further comprising display means for viewing during use of the apparatus by a user.

12. Apparatus according to any preceding claim which
25 comprises a corresponding number of vibration stimulators and pressure sensors.

13. Apparatus according to claim 12 which comprises a first vibrational stimulator associated with a first set of pressure
30 sensors for detecting pressure applied through the hands of a user, and/or a second vibrational stimulator associated with a second set of pressure sensors for detecting pressure applied through the feet of a user.

14. Apparatus according to claim 13 wherein the first set of pressure sensors and first vibrational stimulator are associated with a bar against which a user can push or pull with their hands.

5

15. Apparatus according to claim 13 or 14 wherein the second set of pressure sensors and second vibrational stimulator are associated with a plate against which a user can push with their feet.

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16. Apparatus according to any preceding claim wherein the vibrational stimulator can deliver vibrational stimulation to a user in a plurality of amplitudes, frequencies and/or directions.

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17. Apparatus according to claim 16 wherein the vibrational stimulator comprises one or more individual vibration engines, which are controlled electronically according to parameters stored by the control unit.

20

18. Apparatus according to claim 17 wherein the parameters are manually set by a user prior to use of the apparatus.

19. Apparatus according to any preceding claim which
25 comprises a bar to which a user can apply pressure through their hands, which bar is reciprocally moveable relative to the user.

20. Apparatus according to any preceding claim which
30 comprises a plate to which a user can apply pressure through their feet, which plate is reciprocally moveable.

21. Apparatus according to any preceding claim wherein the

reciprocal movement is substantially towards and away from a user in the plane of symmetry of the user, laterally in a plane substantially orthogonal to the plane of symmetry of a user, a combination of movements in both of said planes, 5 circular movement in one or both of said planes, or a combination of any of such movements.

22. Apparatus according to any preceding claim wherein the direction(s), speed and/or magnitude of the reciprocal 10 movement may be predetermined by the user via the control unit.

23. Apparatus according to any preceding claim wherein the unit can remain substantially stationary relative to a user. 15

24. A method for operating apparatus as defined in any one of claims 1 to 23, which method comprises the user applying an initial pressure which is sensed by a pressure sensor, recording the initial pressure value sensed by the pressure 20 sensor, and applying vibrational stimulation to the user by a vibrational stimulator in response to the user applying pressure to the pressure sensor which exceeds a threshold pressure value determined by the initial pressure value.

25 25. Apparatus substantially as hereinbefore described with reference to the accompanying drawings.

26. A method substantially as hereinbefore described.